Globalization of the International Arms Industry: A Step towards ABCA and NATO Interoperability?

A Monograph
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Abstract

GLOBALIZATION OF THE INTERNATIONAL ARMS INDUSTRY: A STEP TOWARDS ABCA AND NATO INTEROPERABILITY? By MAJ Johnny S Austin, RRF, British Army, 47 pages.

This paper explores the relationship between globalization of the arms industry and interoperability. Its premise is that while the arms industry has undertaken significant steps to globalize, NATO and ABCA military force interoperability levels remain woefully inadequate. Over sixty years ago NATO and the ABCA program sought to standardize the militaries of their member nations. Each member country agreed to take steps to ensure that interoperability among force elements was achieved. A truly globalized arms industry offers a platform to achieve greater standardization and interoperability amongst joint and combined forces. In fact, it is clear that a nexus should exist between a globalized arms development and truly interoperable forces. This study examines the relationship between a globalized arms industry and interoperable armed forces within the context of NATO and the ABCA program. The primary vehicle it uses to do this is a case study of the development and procurement of the Joint Strike Fighter (JSF). The study concludes that four barriers bar the development of interoperable forces. First, defense spending has significantly reduced for all members of NATO and ABCA, with the exception of the United States. Second, democratically elected leaders are unable to justify increased defense spending in financially constrained times. The absence of an identifiable external threat to the sovereignty of nation states is paramount in politician's minds. Thirdly, the proliferation of defense technologies to third parties prevents the arms industry from achieving interoperability of systems. Finally, little emphasis is placed on the importance of non technical interoperability. The requirement of forces to train together and understand differing military cultures and doctrine is often overlooked. The absence of joint and combined training prior to conducting operations has limited the ability of international forces to operate together effectively. Critically, wherever possible, NATO and ABCA forces must achieve both technical and non technical interoperability in order to remain effective within the contemporary operating environment.

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Introduction

In recent years fundamental changes have occurred in the nature, scale, scope and diversity of military operations.[1] Unilateral military operations are extremely rare and given the interconnectedness of the modern world are becoming increasingly unlikely. Joint, combined and coalition operations have dominated military deployments since the early 1990's. Coalitions are often formed in response to impending crisis at short notice and on an *ad hoc* basis. These coalitions are fluid, with partner nations joining and leaving or re-scaling their commitments during the course of the operation. The level at which interaction between national contingents has lowered significantly. During the Cold War alliance partners predominately interacted at the operational level, today this interaction is conducted at the tactical level often between and within Battlegroups. The challenges of multi-national operations are well known, interoperability issues between forces of a coalition compound existing tensions and further complicate operations. The friction encountered amongst elements of a coalition is responsible for decreasing the tempo of operations and jeopardizes the effectiveness of a multi-national operation.

The issue of interoperability in a globalized world is one that merits serious attention. The instances of coalition operations are increasing and the levels of interaction between forces are lowering to such an extent that multinational Battlegroups are a real possibility.[2] Despite the existence of numerous interoperability bodies and working groups, the

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[1]Fewel, Clark, Kingston, Richer and Warne,“ Evaluation of Organizational Interoperability in a Network Centric Warfare Environment.” Ninth International Command and Control Research and Technology Symposium. (Canberra, Defense Science and Technology Organization, 2004),2.

[2] Since Jan 2007 the European Union (EU) has maintained two Battlegroups (1500 men strong) in order to conduct contingency operations. The Battlegroups must be able to conduct peace enforcement and peacekeeping operations within 10 days of receiving a tasking from the EU. They are expected to conduct operations for a maximum of 120 days. In Jan 2008 a Nordic Battlegroup was formed and was comprised of Swedish, Finish, Norwegian, Estonian and Irish troops. This organization was complimented by a second multinational Battlegroup comprised of Spanish, French, German and Portuguese troops. Although these organizations did not deploy they were assessed to be deployable formations.

levels of technical and non technical interoperability are significantly below the level where seamless interaction between tactical units of differing national contingents can take place.

Globalized production in the Arms industry has resulted in the development and delivery of numerous weapon systems and platforms which on face value appear interoperable. However, on closer examination the systems are far from interoperable. The Israeli F16I Sufa (Storm) fighter aircraft is a case in point. Despite sharing avionics and airframes with current Block 50/52 F16 fighters, the F16I is unique. [3] Israeli defense industries customized the F16I by adding improved avionics, targeting systems, electronic warfare suite and sensors. The upgrades have essentially tailored the aircraft to the specific environment Israel requires their military to operate in. Once the upgrades are complete the level of interoperability between F16I and Block 50/52 F16's reduces significantly. This example is by no means unusual; India produces T72 Main Battle Tanks (MBT's) under license and has sold them on the export market as T72M1 Ajeya. The MBT is vastly different from the original models sold to India by Russia. New power packs, gun barrels, armor, communication systems and optics have been added to the tank, creating a regionally optimized MBT. The customization of the platform has resulted in an MBT which could not operate in a formation comprised of unaltered T72's. [4] Development and production of weapon systems has undergone significant globalization; however, globalization of the arms industry is incomplete.

This study aims to explore the relationship between the globalization of the arms industry and interoperability of coalition forces, to establish whether there is a nexus between the two. Understanding whether there is a nexus or not will allow military commanders to understand the

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[3] Global Security.Org. 2007. http://www.globalsecurity.org/military/world/israel/f-16i.htm (accessed 20 Mar, 2009).

[4] Global Security.Org 2007. http://www.globalsecurity.org/military/world/india/t-72.htm (accessed 20 Mar, 2009).

impact of future technology on the efficiency of coalition operations. This research will begin by exploring the theoretical relationship between a globalized arms market and interoperability of forces. It will then examine the changes which resulted in the arms industry due to globalization. In turn, the paper will examine the various types of interoperability and establish how interoperability amongst forces is measured. Finally it will examine the Joint Strike Fighter program and show whether or not there is a link between globalization and interoperability.

This study will prove that the relationship between arms industry globalization and interoperability is tenuous to say the least. Since the end of the Cold War, the arms industry has globalized; however, interoperability levels amongst NATO and ABCA forces remains woefully inadequate for operations in the contemporary operating environment. The apparent nexus between a globalized arms industry and interoperability does not exist; national security and economic policies prevent the benefits from arms industry globalization from influencing interoperability and improving the efficiency of coalition operations. The implications of these findings are far reaching and will undoubtedly affect the viability of truly combined operations. Technical interoperability is vital in complex environments where members of coalitions share battle space. The proposed deployment of U.S. forces to the southern Afghanistan in summer of 2009 poses a significant challenge. United Kingdom and U.S. forces will operate within the same area and will lack truly interoperable communications[5]. The measures employed to ease these issues will not alleviate the potential of friendly fire incidents nor will they ensure unity of effort and unity of command at the lowest tactical levels.

[5] Sandra I Irwin, "Closest of Allies but not when it comes to Radios" (National Defence, August 2007) http://www.nationaldefensemagazine.org/archive/2007/August/Pages/ClosestofAllies2542.aspx

A Theoretical relationship between Arms Industry Globalization and Interoperability

In their paper "Globalization of the Defense Industry: Roles and responsibilities of the Federal Government", Kiefel and Bitzinger present a dilemma for policy makers, in which they consider two conflicting outcomes of a globalized arms industry.[6] On one hand, global arms collaboration provides an opportunity to pool financial and intellectual resources to strive for competitive positions in the global market. On the other, they identify that cooperation in the arms market may threaten a nation's political, economic and military security. They claim that the diffusion of critical defense technology leads to weapons proliferation and an unhealthy dependence on foreign defense firms, which leads to a loss of indigenous arms industry jobs. Despite this tension, in the early post Cold War period, the joint production of arms provided a viable solution to the increasing costs of weapons procurement. As Kevin P O'Prey writes: "transnational cooperation is increasingly viewed as the only affordable way to maintain Research and Development (R&D) and production capabilities."[7]

Collaboration on joint defense projects prior to the end of the Cold War had the full support of the U.S Congress, Kiefel and Bitzinger state that: "In general the U.S congress supported NATO standardization and interoperability, as well as the benefits to the U.S defense industrial base through increased collaborative arms projects." [8] In the 1980's , Congress instituted an initiative known as the 'Nunn Amendment' which allocated funds from the Defense

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[6] Erik Kiefel,and Richard Bitzinger, The Globalization of the Defense Industry: Roles and Responsibilities of the Federal Gervernment (Washington, US: Defense Budget Project, 1994),1.

[7]Kevin O'Prey, The Arms Export Challenge: Cooperative Approaches to Export Management and Defense Conversion (Washington, US: The Brookings Institute, 1995),41.

[8] Erik Kiefel, and Richard Bitzinger, The Globalization of the Defense Industry: Roles and Responsibilities of the Federal Gervernment (Washington, US: Defense Budget Project, 1994),10-11.

Departments R&D budget for joint R&D programs between the U.S and its Allies.[9] Despite concerns over the diffusion of defense technologies and large economic disadvantages (including potential U.S job losses) the pressing demands of the Cold War necessitated this stance. In addition to reducing costs, this program had the intention of increasing interoperability levels amongst the U.S and its allies at a technical level. This technical interoperability proved wanting in the 1991 Gulf War. U.S officials were surprised by the weaknesses of European forces involved in the conflict and sought to remedy this process. Terrence R Guay writing in 2005 stated that: "An easing of restrictions on the sales of military technology to close U.S allies would enhance the interoperability of U.S, NATO and other allied forces." [10] This position is further supported by O'Prey who states: "multilateral cooperation enhances the combat efficiency and effectiveness of military alliances by eliminating wasteful duplication in arms production while promoting standardization and interoperability."[11] It becomes apparent a relationship should exist between a globalizing arms industry and more interoperable military forces.

The combination of reducing defense budgets, the increasing costs of next generation weapon systems and the exponential spread of globalization through the world economy, will increase the pressure on the Defense manufacturers to accelerate globalization efforts.[12] The efficiencies created by a contracted arms industry should pay dividends in the technical interoperability of military forces.

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[9] U.S. Congress, Office of Technology Assessment, Global Arms Trade, OTA-ISC-460 (Washington , DC:U.S Government Printing Office, June 1991), pp. 18 – 21.

[10] Terrence Guay, *The Transatlantic Industrial Base: Restructuring Scenarios and their Implications* (The Strategic Studies Institute, U.S: Army War College, 2005),18.

[11] Kevin O'Prey, The Arms Export Challenge: Cooperative Approaches to Export Management and Defense Conversion (Washington, US: The Brookings Institute, 1995),41.

[12] Richard Bitzinger," The Globalization of the Arms Industry: The Next Proliferation Challenge." (*International Security*: Washington Vol 19, No 2, 19940), 27.

Joint Strike Fighter as a Case Study

In order to test the validity of this hypothesis, this research will set the theory against a case study of multilateral arms industry collaboration. The Joint Strike Fighter program was initiated following a review of four separate tactical aircraft programs. The review established the U.S. Department of Defense (DoD) could not support all four programs within current and future budget constraints. Recognizing the cancellation of the programs would result in a capability gap, the Secretary of Defense directed the establishment of the Joint Advanced Strike Technology program in July 1993. U.S Air force, Navy and Marine Corps requirements were met by one study which would later lead to the JSF program. At $200 billion, the JSF is the largest single acquisition program in DoD history. The JSF is regarded as the model for 21st century acquisition, incorporating inter-service and international cooperation on a scale unprecedented in U.S procurement. A total of 7 NATO countries are involved in the partnership and have contributed $4.5 Billion to the program. Each country involved in the project will participate in an aspect of the JSF construction process. The case succinctly highlights the key issues concerning a globalized approach to defense production and also highlights interoperability issues at both the service and international level.

Terminology

Numerous definitions of economic globalization exist. This study does not seek to account for the numerous permutations and iterations of the definition. The Oxford English Dictionary defines the term globalization as: “The process enabling financial and investment markets to operate internationally, largely as a result of deregulation and improved

communication."[13] I will widen this definition to include the emergence of a world market dominated by multinational companies, leading to a diminishing capacity for national governments to control their own economies. For the purpose of this paper, globalization of the arms industry will focus on the globalization of defense manufacturing.

The Oxford English Dictionary defines the term interoperable as: "relating to the ability to share data between different computer systems, especially on different machines".[14] However in this research the definition is widened to include both technical and non technical exchange of data, services, processes and procedures. This definition is an amalgam of current and proposed NATO, ABCA, U.S, UK and Australian definitions of the term.[15] It should be noted that NATO doctrine provides three separate and interchangeable definitions of the term. The current edition of NATO AAP -6 defines the term in the following ways: "The ability to operate in synergy in the execution of assigned tasks", additionally it states "The ability of military forces to train exercise and operate together in the execution of assigned missions and tasks."[16] The universally accepted term amongst ABCA and NATO allies can been found in NATO QSTANAG 894, which states "the ability of systems, units, or forces to provide services to and accept services from other systems, units or forces and to use the services so exchanged to enable them to operate effectively together."[17] The current accepted term focuses heavily on the technical aspects of interoperability, but mentions little of the non technical aspects which are essential for coherent

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[13] Sarah Tulloch,ed.,The Oxford Dictionary and Thesaurus (Oxford, UK: Oxford University Press, 2008),s.v."globalization."

[14] Sarah Tulloch,ed.,The Oxford Dictionary and Thesaurus (Oxford, UK: Oxford University Press, 2008),s.v."interoperable."

[15] American, Britain, Canada and Australia (New Zealand not included in the Acronym) Program established in 1946 to foster standardization and interoperability amongst its member nations. It is not an alliance. It is a forum for interoperability issues.

[16] Allied Administrative Publication 6 NATO Glossary of Terms and Definitions (United Kingdom: Ministry of Defence, 2008),197.

[17] NATO Handbook 2006. http://www.nato.int/docu/handbook/2006/hb-en-2006.pdf

and effective coalition operations. Clark T and Jones R developed an organizational interoperability model which focused on the human activity level and its essential relationship with command and control.[18] This model provided impetus for both the UK and Australian defense technology communities to further investigate the requirement for both the interoperability of systems and people. By identifying the technical and non technical interoperability issues within a coalition the commander can manage or mitigate potential areas for friction and enhance his forces capabilities.[19]

Globalization of the Arms Industry

The end of the Cold War forced defense firms around the world to reframe and adapt to a dramatically different operating environment. Kiefel and Bitzinger state that: "In an era of shrinking military budgets and increasingly competitive arms markets, both governments and defense industries are finding globalization essential to the continued efficiency and viability of arms production." [20] In the early 1990's, the cataclysmic changes which occurred in the political, economic and military spheres resulted in the creation of a new international dynamic.[21] This dynamic initiated a dramatic evolution in the global arms industry.

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[18] Fewel, Clark, Kingston, Richer and Warne. " Evaluation of Organizational Interoperability in a Network Centric Warfare Environment." (Ninth International Command and Control Research and Technology Symposium. Canberra,Defense Science and Technology Organization, 2004),3.

[19]Stewart, Clarke, Goillau, Verrall and Widdowson. "Non Technical Interoperability in Multinational Forces." (Ninth International Command and Control Research and Technology Symposium. Farnbrough,QinetiQ, 2004), 4-7.

[20] Erik Kiefel, and Richard Bitzinger, The Globalization of the Defense Industry: Roles and Responsibilities of the Federal Gervernment (Washington, US: Defense Budget Project, 1994),1.

[21] Richard Bitzinger, *Towards a Brave New Arms Industry* (New York: Oxford University Press, 2003),5.

The arms industry experienced a rapid decline; overcapacity brought on by the end of the Cold War and the defense build ups of the 1980's created stagnation in the market.[22] In general, countries that could afford to pay for arms already possessed more arms than they wanted, while those which aspired to purchase new weapons no longer had the money or the strategic assistance to buy them. As Kevin P. O'Prey writes: " the end of the cold war resulted in a paradoxical situation in which states desiring weapons cannot afford them, and many of the states that can afford them are uninterested."[23] The large arms producing countries were forced to cut back production or close certain elements of their arms industry. Hundreds of thousands of defense workers were made redundant as the industry underwent unprecedented restructuring, both on a national and global scale. Bitzinger states: "The number of major defense firms declined dramatically as companies have either merged, or purchased the military assets of other corporations leaving the defense business."[24] This contraction of the defense industry reached its zenith in the mid 1990's; many countries with smaller indigenous arms industries left the business, never to return. In response, transnational collaboration between defense firms in the form of consortia, joint ventures companies, cross border mergers and acquisitions became increasingly common as the defense industries sought to remain viable.

The resulting globalization of the arms industry involved a significant move away from the traditional patterns of arms production, which had been largely dominated by indigenous production, toward a transnational approach to the development and production of arms.[25] The

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[22] Kevin O'Prey, The Arms Export Challenge: Cooperative Approaches to Export Management and Defense Conversion (Washington, US: The Brookings Institute, 1995),17.

[23] Ibid,5.

[24] Richard Bitzinger *Towards a Brave New Arms Industry* (New York: Oxford University Press, 2003),5.

[25] Richard Bitzinger, – *Defense Markets in Transition* (Washington: Defense Budget Project,1993), 3-4.

long term viability of the major arms producing countries industries was never in doubt. Their experience during the Cold War of licensed production and joint ventures created an industry capable of adaption. Countries may have been compelled to internationalize their arms procurement process; however, they would never consign their defense industry capabilities to history.[26]

The defense industry, like many other high technology industries established that the development of integrated global linkages and operations were crucial to survival.[27] What were once considered to be national defense industries are now acquiring global identities and functioning as global networks as opposed national assets. As Lavallee writes: "Practices, such as joint ventures, subcontracting, licensing and inter-firm agreements call into question the defense industrial base as a national asset."[28] National arms producing industries, which were established and funded in the 1930's, to provide states with effective control over military production have been replaced. Skons and Weidacher state that: "National arms producing facilities…have gradually been replaced by, or transformed into, private commercial companies producing weapon systems for the state on contract."[29]

Post Cold War Trends

In its annual report of 2007, the Stockholm International Peace Institute Research Institute (SIPRI) identified four clear trends that have developed in the defense industry since the

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[26] Richard Bitzinger *Towards a Brave New Arms Industry* (New York: Oxford University Press, 2003),6-7.

[27] Richard Bitzinger, – *Defense Markets in Transition* (Washington: Defense Budget Project,1993), 2. (Add to Bibliography)

[28] Tara Lavellee. "Globalizing the US Defense Industry: Understanding Government- led and Industry Driven Cooperation Initiatives." (Conference Papers - - International Studies Association: 1, 2004),3.

[29] Stockholm International Peace Research Institute Yearbook, 2002:6 http://www.sipri.org/contents/milap/milex/aprod/privatization.pdf (accessed 20 Nov,2008).

end of the Cold War. Foremost, the industry has undergone significant structural changes. At the national and international level the arms industry has become increasingly concentrated. The market share of the top five global defense industries rose from 22% in 1990 to 43% in 2005.[30]

Second, there are clear and significant qualitative changes in the nature of technology. This is due to the importance of civilian technology for weapon systems. Civilian information technology firms and electronics companies are heavily involved in providing technology and support at every stage of arms production. In the past, the defense industry provided technology "spin offs" to the civilian sector, this tended to be an important argument in the value of national defense industries. Today, civilian companies are more likely to be "spinning in" cutting edge technology which has both civil and military applications. Additionally, the use of standard civilian components in the manufacture of weapons is an increasing feature of the arms industry: many civilian firms supply off the shelf technology and do not consider themselves part of the arms industry.

Thirdly, compositional changes have dramatically affected the arms industry. Privatization and outsourcing of defense services and support is drawing new kinds of suppliers into military contracting. The majority of the revenue for this military service industry is found in support roles such as logistics, training, maintenance and repairs, information technology services and facilities management. Such services have been the norm for the U.S and UK for some time now, and are increasingly becoming so for other western countries. Defense firms traditionally provided maintenance support, however, now they are expanding their roles in disparate service areas and specialized roles. Finally and most importantly, continuity appears to be an underlying

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[30] Stockholm International Peace Research Institute Yearbook, 2007:6 http://yearbook2007.sipri.org/ (accessed 20 Nov,2008).

trend. Despite significant changes to the industry and predictions of further change, it is important to recognize that the arms industry continues to have a unique set of characteristics and qualities that set it apart from civilian industry.[31]

Hub and Spoke Model

It has long been accepted that the globalization of the arms trade has resulted in the emergence of an intertwined and hierarchical industry, which is increasingly orientated around an international division of labor. While it has long been accepted that the arms industry is hierarchal, few writers have agreed on a clearly defined model which encompassed all elements of the industry. In 2003, Bitzinger proposed that the arms industry was comprised of three tiers. The first tier is comprised of U.S, Russia, Germany, France and the UK. This first tier possesses the largest and most technically advanced defense industries in the world. These countries dominate the global R&D process and sold $292 Billion of arms around the world in 2006.[32] Approximately 80% of the volume of major conventional weapons sales, for the period 2003-2007 was accounted for by this first tier of arms producers.[33]

The second tier comprises a hugely diverse group of countries which are split between three elements. The first element, accounts for industrialized countries which possess a small but highly sophisticated defense industry. Australia, Canada, the Czech Republic, Norway, Japan and Sweden fall into this category.[34] The second element is comprised of developing or recently

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[31] Stockholm International Peace Research Institute Yearbook, 2007:6 http://yearbook2007.sipri.org/ (accessed 20 Nov,2008).

[32] Stockholm International Peace Research Institute Yearbook, 2007:14 http://yearbook2008.sipri.org/ (accessed 20 Nov,2008).

[33] Ibid.

[34] Richard Bitzinger *Towards a Brave New Arms Industry* (New York: Oxford University Press, 2003),5.

industrialized countries with modest military–industrial complexes, such as Argentina, Brazil, Taiwan and Turkey. Finally this second tier includes China and India. Their industries are large and broad based, however they lack fully independent R&D and industrial capacities to develop and produce highly sophisticated conventional arms.

The final tier of the arms industry is comprised of states which maintain a limited and low technology arms production capability. Egypt, Mexico and Nigeria fall into this category. The two lowest elements of the arms industry hierarchy are facing increasing pressure to radically rethink and refocus their arms industry. The four key trends of structural contraction, technological advances, compositional integration and continuity of first tier producers within the global arms market is forcing these producers to accept radically different roles. For most, it results in cancelling large scale indigenous arms projects and accepting a more integrated and subordinate role in an increasingly interdependent defense industry.[35] These 4 tiers and the relationships between them have been grouped into a model by Bitzinger.

Bitzinger states that: "Structurally, such a system could resemble a huge 'hub and spoke' model."[36] The first tier producers are located in the middle, serving as 'centers of excellence' for R&D and systems integration. From the hub, global supply chains would extend to second and potentially third tier states on the periphery. This model exponentially increases the importance of first tier producers, in support of this; Mussington claims that choke point vulnerabilities become evident in two ways. He states, firstly that: "Dependencies …are useful instruments for manipulating client –state defense postures." [37] Mussington also points to: "The more complex the weapon second tier producers manufacture, the more import dependent - they are likely to

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[35] Richard Bitzinger *Towards a Brave New Arms Industry* (New York: Oxford University Press, 2003),7.

[36] Ibid

[37] David Mussington, David. Arms Unbound: *The Globalization of Defense Production*. (Washington: Brassey's Incorporated, 1994),54.

become for key subsystems."[38] Although this model has profound consequences for arms proliferation and control, it is clear that first tier producers are able at numerous levels to influence the process.

As defense industries became more transnational, the challenge for Western policymakers is how to best promote the benefits of globalization while ensuring that this does not adversely affect national security. In the words of Bitzinger the challenge will be to: "distinguish between 'good' globalization and 'bad' globalization."[39]

Opportunities and Incentives

Having identified the current and projected trends associated with the globalization of the arms industry; I will now turn to examining the opportunities and incentives that have occurred due to the evolution of the arms industry. In 1993, Bitzinger wrote that: "Globalization of the arms industry is to some extent inevitable and even desirable…it permits western arms manufacturers to pool their financial and intellectual resources in order to be more competitive and cost efficient in an increasingly tight global market place."[40] The economic factor in arms production is as important today as it was at the end of the Cold War. Rising costs in the development and production of arms, coupled with low production runs have significantly affected the appetite of many nations to maintain national indigenous arms industries. Navias and Willet state: "That Research and Development costs of a major weapon system account for

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[38] Ibid

[39] Richard Bitzinger *Towards a Brave New Arms Industry* (New York: Oxford University Press, 2003),83.

[40] Richard Bitzinger," The Globalization of the Arms Industry: The Next Proliferation Challenge." (*International Security*: Washington Vol 19, No 2, 19940), 27.

roughly 30% of their unit costs."[41] This figure is prohibitive for many nations and as such, the incentive to enter into collaborative arms programs is extremely appealing. Numerous writers on the arms industry including Bitzinger, Kiefel, O'Prey, and Lavallee all agree that a globalized arms industry significantly reduces individual nation R&D costs. This saving allows countries with small defense budgets to share in the benefits of high technology weapons systems, which otherwise they could not have afforded. In addition, this process ensures that wasteful duplication of technological R&D is eliminated amongst allies and partner nations.[42] The results of this process include far greater economies of scale in the development and production of new weapons systems. This process also ensures the preservation of domestic arms industry jobs and defense industrial capabilities.[43] Finally, and most importantly in the context of globalization, this process encourages the development and penetration of foreign arms markets that otherwise may have been closed.

The political implications and opportunities of a globalized arms industry have been well documented. O'Prey and Lavallee both agree defense collaboration promotes greater political and military cohesion amongst allies, and enhances partner capabilities and effectiveness in military alliances.[44] The strategic alliances generated by a globalized arms market are routed in economic pressures to reduce costs; however, existing relations amongst partner nations are a prerequisite where transfers of defense technology are involved. States will seek to partner with other states that have displayed a willingness to cooperate on a wide range of issues and proved

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[41] Martin Navias and Susan Willett, *The European Arms Trade* (New York: Nova Science Publishers, Inc, 1996),18.

[42] Richard Bitzinger," The Globalization of the Arms Industry: The Next Proliferation Challenge." (*International Security*: Washington Vol 19, No 2, 19940), 3.

[43] Ibid.

[44] Kevin O'Prey, The Arms Export Challenge: Cooperative Approaches to Export Management and Defense Conversion (Washington, US: The Brookings Institute, 1995),41.

their reliability. Concerns were raised following the 1991 Gulf War that a technology gap was developing between U.S and European forces. U.S export controls were hampering efforts to maintain technical interoperability of forces within NATO. The fear was that, not only was the alliances viability in jeopardy, but also the ability of European Defense industry to generate innovation in modern weapons was brought into question. Without serious competition it was feared that U.S. arms industries would stagnate and lacking the incentive to continue innovating new technologies and systems in order to stay ahead of near peer competitors.

Transatlantic defense trade links and the inclusion of the commercial sector into the arms production process are an undoubted source of improved cohesion within military and political alliances. The commercial sector is now a driver rather than a beneficiary of military technology. The U.S Defense Science Boards report on Globalization and Security stated that: "The commercial sector, which pays scant attention to national boundaries, is now driving the development of the advanced technology into modern information-intensive military systems."[45] This not only lowers the cost of weapon systems, but improves innovation and competition. The net result is a reduced weapon systems product development cycle and much shorter commercial timelines. These temporal savings have resulted from more efficient industry practices.

According to SIPRI in 2007, there were 53 significant arms industry mergers and acquisitions between North American and Western European firms. Of these, three were cross border deals within Europe and 16 were transatlantic deals. The majority of the transatlantic deals were between British and U.S. companies. Most of the deals related to military services or two sub systems, predominantly in the electronics and aerospace sectors. A total of 7 of these mergers/acquisitions had values of over $1 Billion. Four of these were U.S. domestic

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[45] Department of Defense Science Board Task Force Report, Globalization and Security,1999:ii. http://www.acq.osd.mil/dsb/reports/globalization.pdf

acquisitions; two involved the purchase of U.S firms by a British company and one the acquisition of a British operation by a U.S company.[46]

Weaknesses and Pitfalls

Defense industry globalization poses a distinct dilemma for policymakers. Balancing the competing interests of political, economic and military security is problematic when dealing with a globalized defense industry. Co- development of arms is seen to have benefits, but the pitfalls are widely apparent amongst the U.S. defense community. The Chairman of Northrop Grumman, Ron Sugar, accurately captured the dilemma when he stated that: "We're not just making toothpaste; we're in the business of national security. National borders do matter."[47] His opinion is one shared by many in the U.S. DoD. Despite many platitudes to alliance interoperability and improving the transfer of defense technology, the hard wiring for defense industry globalization is still not in place. Bialos writes: "We are not ready – institutionally, culturally or politically – to create a truly transatlantic set of primes that draw transformational R&D from the U.S. and its allies and share technology across national boundaries."[48] A commonly held perception in Europe and in CONUS is the U.S stresses its own national security concerns over economics in arms production.[49] This perception is fueled by reality when measured against the following factors

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[46] Stockholm International Peace Research Institute Yearbook, 2007:14 http://yearbook2008.sipri.org/ (accessed 20 Nov,2008).

[47] Jeffery Bialos, "Last Supper Fallout: Can Defense Industry Meet Tomorrows Challenges." (Defence News, 2003. http://transatlantic.sais-jhu.edu/PDF/articles/bialos_competition_oped.pdf accessed 24 November 2008),3.

[48] Jeffery Bialos, "Last Supper Fallout: Can Defense Industry Meet Tomorrows Challenges." (Defence News, 2003. http://transatlantic.sais-jhu.edu/PDF/articles/bialos_competition_oped.pdf accessed 24 November 2008),3.

[49] Terrence Guay, *The Transatlantic Industrial Base: Restructuring Scenarios and their Implications* (The Strategic Studies Institute, U.S: Army War College, 2005),17.

The U.S. is conscious of the fact, that diffusion of defense technologies has many unwanted outcomes. Primarily, globalization does not just aid proliferation of arms it also increases the capacity of states to build their own high-tech weapons. A major concern of the U.S. is that technologies are shared with a third party whose interests are not directly in line with the U.S interests. In 2003 the EU, and more specifically France and Germany indicated that they wished to end the arms embargo on China, which had been in place since the 1989 Tiananmen Square incident.[50] In response, in May 2004, the U.S House of Representatives Armed Services committee approved legislation that would impose harsh export restrictions on the sales of U.S defense technology to any country selling arms to China. This was complimented by an amendment barring the DoD for 5 years from doing any business with a company that sells arms to China. [51] U.S. interests in maintaining the balance of power in East Asia was undoubtedly the source of this legislation.

The U.S Senate and House of Representatives policies on technology transfers are so fractured it actually hampers arms collaboration. One underlying source for this can be found in the protectionism of U.S defense industry jobs and retention of a viable indigenous defense industrial base. Globalization has affected U.S industry on many scales, outsourcing of jobs to other countries is one of the most contentious for the American voter. It is hard to believe a Senator or Representative would place economies of scale and interoperability above ensuring jobs for his electors. This problem is further exacerbated when arms collaboration projects are created on the understanding that partner nations will receive a share of the production workload.

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[50] In 1989 the Chinese army was used to crush a peaceful demonstration in support of the death of the pro-democracy leader Hu Yaobang. Official Chinese records state that 300 protestors were killed. Unofficial records suggest as many as 3000 protestors were killed.

[51]Terrence Guay, *The Transatlantic Industrial Base: Restructuring Scenarios and their Implications* (The Strategic Studies Institute, U.S: Army War College, 2005),18.

Nations contribute funds in the early stages of a collaboration project in order to gain access to both technology and production. The Joint Strike Fighter project provides a perfect example to illustrate this issue. Despite contributing $ 0.125 Billion to the project, Norway threatened to pull out of the project unless Lockheed Martin assisted Norwegian defense industry to secure work on the aircraft. [52]

Defense technology transfer has and will continue to create niche manufacturers of highly sought after defense systems. Most notably, second tier arms producers are capitalizing on core competencies, such as the production of ISR platforms and optical sensors. Israel, South Africa and Sweden have benefited enormously from technology transfers; and have gone on to become market leaders or provide stiff competition to first tier arms manufacturers. This competition, although healthy in terms of innovation, is detrimental to domestic markets. Foreign competitors are able to penetrate domestic markets and sell products at highly competitive rates.[53] This phenomenon has been assisted by the current demands of operational theatres, for example in 2007 the United Kingdom purchased 67 new weapon systems, as a result of urgent operational demands from theatre. Of these, 30 were sourced from second tier, non domestic arms producers.[54]

While the U.S remains committed to joint armaments programs such as the JSF and missile defense, interoperability and standardization are difficult to achieve as the U.S armaments policy remains divorced from the technology transfer policy. The advantages of interoperable forces are weighed against the technology gap the U.S wishes to maintain above its

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[52] Terrence Guay, *The Transatlantic Industrial Base: Restructuring Scenarios and their Implications* (The Strategic Studies Institute, U.S: Army War College,2005),17.

[53] Richard Bitzinger *Towards a Brave New Arms Industry* (New York: Oxford University Press, 2003),68.

[54] Operations: A Year End Assessment (Infantryman, UK, 2007),19.

near peer competitors.[55] This is further supported by the concerns of the Defense Science Board relating to modern internet based business environments. In a report written in 1999 the Board highlighted that: "Such global interconnectivity could provide potential adversaries an open source intelligence boon."[56] The tensions of maintaining a viable and secure national defense industry are at odds with a globalized arms market. It is clear that the U.S. is still attempting to reconcile this issue and as such many of the potential benefits of a globalized arms industry are unrealized.

Transatlantic versus Bipolar Defense Industrial Base

The global economic market may be ripe for transatlantic collaboration opportunities; however, significant political obstacles constitute a formidable barrier in both the U.S. and Europe. Perhaps the most critical factor is the disparity in defense spending between the U.S and Europe. SIPRI identified that U.S. defense spending dropped by a significant 20.8% during the period 1989 to 1999. However, four years later defense spending returned to 1989 levels. In 2007 the U.S topped the SIPRI defense spending chart with a figure of $547 Billion spent on defense, a figure almost 10 times the amount of the second placed country, the United Kingdom at $59.7 Billion[57]. In general, Europe has slashed defense spending and is spending 14% less on arms than it did in 1989. Guay states that: "An increase in defense spending would serve to strengthen Europe's defense industry…then European firms would be in a better position

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[55] Jeffery Bialos, "Last Supper Fallout: Can Defense Industry Meet Tomorrows Challenges." (Defence News, 2003. http://transatlantic.sais-jhu.edu/PDF/articles/bialos_competition_oped.pdf accessed 24 November 2008),3.

[56] Department of Defense Science Board Task Force Report, Globalization and Security,1999:iii. http://www.acq.osd.mil/dsb/reports/globalization.pdf

[57] Stockholm International Peace Research Institute Yearbook, 2007:14 http://yearbook2008.sipri.org/ (accessed 20 Nov,2008).14.

to negotiate with U.S firms."[58] Given the weak position of EU defense firms it is unlikely that U.S. firms would actively seek out greater transatlantic ties.

Europe's leaders have indicated through numerous projects, including the Galileo project that it may be opting for a bipolar path to arms production [59]. The U.S. fear of state of the art technology transfers will ultimately result in their enemies gaining intimate knowledge of U.S. systems does not help. The common perception in Europe is that the U.S stresses its own national security above economics and alliances. With that said traditional defense collaborations are viable and are still occurring, the Joint Strike Fighter (JSF) is a case in point. Guay suggests that: "Despite these formidable obstacles, signs are that a transatlantic defense industrial base is feasible."[60] Since 2003, numerous U.S. defense firms (Including General Electric, Lockheed Martin and General Dynamics have attempted to buy stakes or merge with European companies. Although smaller in scale European firms, most notably BAE systems (UK), have successfully acquired U.S based companies.

In order to steer towards a transatlantic arms market Guay recommends the following approaches should be adopted in the U.S. Initially, the Federal Government should open its defense markets to more European firms whilst simultaneously encouraging EU governments to do the same. In addition, the U.S. Government must seek to enhance NATO's ability to award contracts and procurement – coordinating authority. Secondly, the U.S. military must work more

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[58] Terrence Guay, *The Transatlantic Industrial Base: Restructuring Scenarios and their Implications* (The Strategic Studies Institute, U.S: Army War College,2005),16.

[59] A joint undertaking by the EU and European Space Agency, to develop an alternative to the U.S. Global Positioning System. The EU views this project as a move away from dependence on the Pentagon and as a step towards common defense. Disturbingly for the U.S. China, India and Israel are involved in the collaboration.

[60] Terrence Guay, *The Transatlantic Industrial Base: Restructuring Scenarios and their Implications* (The Strategic Studies Institute, U.S: Army War College,2005),18.

closely with EU counterparts in order to coordinate procurement requirements. This will not only improve interoperability but will reduce the costs of weapon systems through cost sharing. Finally U.S. defense companies should adopt two strategies. The first involves identifying possible acquisition targets and the second focuses on subcontracting technologically sensitive production to EU defense companies. Clearly both approaches would face significant opposition from the EU and U.S. governments.[61]

Interoperability

"Coalition war fighting is not like a pickup game of basketball, rather, it requires joint training, new doctrine and creating institutional 'plug and play' command and control architectures"[62]

In order for an alliance or coalition to operate effectively, it is essential that national contingents are able to achieve high levels of interoperability at both the technical and non technical levels. Moreover, interoperability is a fundamental principle crucial for the success of joint and combined operations. As coalition operations within, and outside existing alliances, become the norm, rather than the exception the issue of interoperability between national forces becomes ever more pressing. Two key challenges have emerged since the 1990's; firstly, the level of hierarchy at which regular multinational interaction has been significantly lowered. For example, during the Cold War, the British Army of the Rhine (BAOR) would have typically coordinated operations with its allies at the Corps or Division level. Today, interaction occurs

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[61] Terrence Guay, *The Transatlantic Industrial Base: Restructuring Scenarios and their Implications* (The Strategic Studies Institute, U.S: Army War College,2005),19.

[62] Jeffery Bialos, "Last Supper Fallout: Can Defense Industry Meet Tomorrows Challenges." (Defence News, 2003. http://transatlantic.sais-jhu.edu/PDF/articles/bialos_competition_oped.pdf accessed 24 November 2008),3.

within Brigades and occasionally at the Battlegroup level.[63] This significantly increases both the technical and human interoperability challenges and places strain on systems and processes which were not designed to operate in such a manner. In addition, there is the major challenge of operating with unfamiliar nations. *Ad hoc* coalitions formed to deal with an international crisis may present strategic advantage; however, they also present significant operational and tactical challenges. Multi-national force commanders are highly likely to inherit 'coalitions of the willing' formed to meet political objectives, rather than operational and tactical requirements.[64] It should be understood that coalition warfare and multi-national operations are often conducted by nations who possess different and competing national interests and perspectives. As Clausewitz wrote, "One country may support another's cause, but will never take it as seriously as its own."[65] Nations will enter into coalitions and alliances because it is in their own best interests. Rarely is it done out of sympathy or out of a sense of gratitude towards others.

In short, war by committee never has been, nor will it be an easy path to victory. In fact, the level of complexity grows exponentially when operating within a coalition or an alliance. The needs of competing national chains of command must be balanced throughout the planning and execution of an operation. Where national will, capacity and understanding differ, planners and commanders face significant challenges. It should also be stressed that high levels of interoperability amongst national contingents does not necessarily result in a high level of performance as Fewel states: "A single organization operating alone may be able to optimize its

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[63] Stewart, Clarke, Goillau, Verrall and Widdowson. "Non Technical Interoperability in Multinational Forces." (Ninth International Command and Control Research and Technology Symposium. Farnbrough,QinetiQ, 2004), 3.

[64] Ibid

[65] Carl Von Clausewitz, *On War*, trans. And ed. By Michael Howard and Peter Paret (New Jersey:Princeton University Press, 1989)

performance."[66] Organizations which differ in structure and technological compatibility often have to compromise methods and approaches in order to achieve a level of interoperability. Clearly this is a sub-optimal situation and should be avoided if at all possible. In the past, for example in Cold War Europe, collaboration amongst NATO allies was achieved by dividing operational tasks into discrete and non intersecting parts; this approach required extremely low levels of interoperability and could be achieved given the long term understanding within the organization. In recent years, there have been significant changes in the nature, scale, scope and diversity of military operations. The Contemporary Operating Environment (COE) is characterized by coalition operations formed on an *ad hoc* basis and often at extremely short notice. Fewel writes that coalitions: " …can be fluid, with partners joining and leaving or rescaling their commitments during the course of the collaboration."[67] In addition, coalition members rarely possess equal military capabilities, often nations are limited in the skills and capabilities they are able to provide.

With that said, there are various factors which make it highly desirable for nations to enter into a coalition. Economy of effort is a clear motivating factor when forming coalitions. The ability to share the burden significantly reduces financial costs in military operations. In addition to this, national contingents may possess niche skills and capabilities which other partners within the coalition may lack. Very few nations are able to mount large scale expeditionary operations and even fewer are able to meet every contingency on their own.[68] Finally, the wider political

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[66] Fewel, Clark, Kingston, Richer and Warne," Evaluation of Organizational Interoperability in a Network Centric Warfare Environment." Ninth International Command and Control Research and Technology Symposium. (Canberra, Defense Science and Technology Organization, 2004),4.

[67] Ibid,1.

[68] Fewel, Clark, Kingston, Richer and Warne," Evaluation of Organizational Interoperability in a Network Centric Warfare Environment." Ninth International Command and Control Research and Technology Symposium. (Canberra, Defense Science and Technology Organization, 2004),4.

considerations encountered when using military force must never be underestimated. The legitimacy conveyed by a coalition is increasingly important in a globalized world.

Improving interoperability amongst members of a coalition or an alliance is predominantly concerned with improving the effectiveness of interactions, and as such is not directly linked to performance and outcomes.[69] It is however, generally accepted that a high level of interoperability is one of numerous factors which are responsible for improving military outcomes. The COE presents a significant challenge to militaries, interoperability must be planned for and it must also be flexible. The sheer scale and variety of scenarios and participants in a coalition task force make it impractical to be prescriptive. It is essential that a process driven approach is adopted. [70]

According to NATO doctrine, failure to address interoperability issues can lead to deficiencies in the area of procedures, material, doctrine and terminology. [71] As such, problems will manifest themselves in the following five areas. First, procedural and tactical differences present the force with situations where units from different services or nations are unable to work together effectively due to lack of capability. Where language difficulties arise communication problems occur which may result in differences in the interpretation of missions and assigned tasks. The lack of system compatibility can cause technical difficulties to arise. The inability to exchange information, intelligence, technical data or communications results from a lack of interoperability and national security concerns. Finally, the inability to use common sources may result in the degradation of logistic capabilities.

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[69] Ibid

[70] Thea Clark and Terry Moon. "Interoperability for Joint and Coalition Operations." (*Australian Defence Force Journal* No 151, 2001),2.

[71] Allied Joint Publication 01 (B) NATO Allied Joint Doctrine (United Kingdom: Military of Defence, 2002),248.

Interoperability Forums and Oversight

At the end of World War Two General Dwight D. Eisenhower said that mutual confidence is the one basic thing that will make allied commands work. This mutual confidence can only stem from a combination of tangible actions and entities and intangible human factors. Although they do not guarantee success, ignoring them will usually result in failure.[72] In 1947, Eisenhower and Field Marshall Montgomery agreed to foster and capitalize on the close cooperation between the allies during the War World War II by entering into an agreement known as the 'Plan to effect standardization.' The agreement focused on ensuring the armies of the United States, Great Britain and Canada were able to operate effectively together. In 1954, the plan was replaced by the "Basic Standardization Concept" and in 1963 Australia joined the organization. On the 10th of October 1964 the armies of the U.S., UK, Can and Aus formed the American, British, Canadian and Australian Standardization Program, universally known as the ABCA program. New Zealand attained observer status within the organization in 1965 under the sponsorship of Australia and in 2006 formally joined the program.

Since its inception the program has focused on interoperability, defined by the ABCA as: "The ability of alliance forces, and when appropriate, forces of partner and other nations, to train, exercise, and operate effectively together in the execution of assigned missions and tasks."[73] The member nations acknowledge that future operations are likely to be conducted within a coalition of ABCA and other willing nations. In order to prepare for future operations during peacetime the program seeks to achieve effective integration of the capabilities necessary to enable ABCA armies to conduct the full spectrum of coalition land operations successfully in a joint environment, now and in the future. The program has identified the following aims, firstly to

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[72] *American, British, Canadian Australian (ABCA) Coalition Operations Handbook*,(ABCA Publication 332, Army Code 56437. United Kingdom: Ministry of Defence,2008),5.

[73] Ibid

achieve the fullest cooperation and collaboration amongst ABCA armies. Secondly, it seeks to achieve the highest levels of interoperability amongst signatory armies, through material and non material standardization. Finally, the program wishes to achieve economy through the use of combined resources and effort.

The ABCA program is not an alliance nor has an ABCA force ever been employed under the program. Member nations have, however, served together in *ad hoc* coalitions to pursue common objectives. The work undertaken by ABCA has assisted in the smooth functioning of the coalition. Whilst the ABCA program has achieved some levels of standardization amongst the member nations, no common doctrine exists between the armies nor are they fully technically interoperable. The program has merely improved the understanding between forces and provided commanders with the knowledge and skills to form and operate coalitions and achieve the best out of ABCA forces. Since culturally the member nations share many similarities they have faced fewer obstacles to non technical interoperability than with nations with divergent cultural outlooks, however, differences do exist and these coupled with technical interoperability issues affect coalition effectiveness.[74]

The North Atlantic Treaty Organization (NATO) maintains a number of bodies which seek to promote standardization and interoperability amongst alliance members. The principle forum for the elaboration of standardization policy is the NATO Standardization Organization (NSO). Formed in 1995, the NSO's mission is to develop, agree and implement concepts, doctrines, procedures and designs in order to achieve and maintain interoperability.[75] Extensive effort is expended by the NSO to improve cooperation and to eliminate wasteful duplication of effort in the areas of R&D, production, procurement of logistic support of defense systems. This

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[74] *American, British, Canadian Australian (ABCA) Coalition Operations Handbook* (ABCA Publication 332, Army Code 56437. United Kingdom: Ministry of Defence,2008), 11.

[75] NATO Handbook 2006:349.. http://www.nato.int/docu/handbook/2006/hb-en-2006.pdf

is primarily conducted through the development and promulgation of NATO Standardization Agreements, known as STANAGs. The implementation of STANAGs assists countries to achieve and maintain required levels of interoperability within the alliance. Disturbingly, STANAGS are readily signed by member nations, but are rarely fully implemented.[76] This is due to the fact that: "standardization is a voluntary process."[77] STANAGS are often signed by a handful of member nations and implemented by only a percentage of those who took part in the agreement. The result of this process is extremely divisive, with standardization/interoperability being achieved at limited levels amongst some member nations, whilst others remain outside the agreement.

The NATO Committee for Standardization (NCS) is the senior NATO authority on standardization and reports directly to the NATO council. It is supported by national representatives who provide harmonization and guidance at the delegate level under the direction and management of the committee. The NCS is chaired by the Secretary General of NATO, however, in practice; he is represented by two co-chairmen, the Assistant Secretary General for Defense Investment and the Director of International Military Staff. Since 2000, partner nations are actively involved in NSC activities. Subordinate to the NSC is the NATO Standardization Staff Group (NSSG) the principle task of the NSSG is to: "…harmonize standardization policies and procedures and to coordinate standardization activities with NATO bodies. The NSSG is responsible for the preparation and formulation and drafting of Standardization objectives for the STANAG program. The NSSG is comprised of representatives from the Strategic Commands and staff from the International Military Staff. These bodies are responsible for authorizing the production of STANAGS and Allied Publications by the following subordinate groups. Namely

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[76] Allied Joint Publication 01 (B) NATO Allied Joint Doctrine (United Kingdom: Military of Defence, 2002),240.

[77] NATO Handbook 2006:351.. http://www.nato.int/docu/handbook/2006/hb-en-2006.pdf

the Military Committee, the Conference of National Armament Directors (CNAD),[78] the Senior NATO logistics Conference and the NATO Consultation, Command and Control Board. Finally, the NATO Standardization Agency (NSA) is an integrated body which is responsible for standardization across the services and for the management of the service boards (Navy, Army, Air force). These boards are comprised of a representative per member nation and meet formally 8- 10 times a year.[79] These formalized bodies, which seek to ensure standardization and interoperability are met within the alliance, are significantly disadvantaged due to the fact that the process is entirely voluntary. NATO will not impose penalties on member nations failing to meet standards; as such the levels of interoperability and standardization are limited.[80] The major driving factor behind failure to meet standards is the economic costs which are prohibitive for many major nations.

Technical Interoperability

Interoperability has generally been accepted to imply the compatibility of military hardware and software, for example communication and information systems or weapons. NATO doctrine and through it, U.S and UK doctrine stresses that interoperability is: "The ability of systems, units, or forces to provide services to and accept services from other systems, units and forces and to use these services …to operate effectively together."[81] Technical compatibility amongst coalition forces can assist in mitigating Clausewitizian 'friction' and is a necessary but insufficient precondition for interoperability on current and future operations.

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[78] The Conference of National Armament Directors (CNAD) is comprised of senior defense acquisition officials from member nations and military representatives from the Military Committee and Strategic Commands.

[79] NATO Handbook 2006:351.. http://www.nato.int/docu/handbook/2006/hb-en-2006.pdf

[80] Ibid, 352.

[81] Allied Joint Publication 01 (B) NATO Allied Joint Doctrine (United Kingdom: Military of Defence, 2002),325.

Current doctrine, suggests interoperability of forces is addressed simply by agreeing to appropriate technical standards that allow technical interface to be determined, and if resources are available, addressed.[82]

It is certain that the modern battlefield requires heavy reliance on technical systems which provide Command, Control, Communications and Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) functions. Without compatibility of C4ISR systems, integrated coalition operations are highly difficult to achieve. The barrier to achieving this compatibility is generally accepted to be financial. Adams, Ari, Longdon and Williamson write that: "The biggest constraint on…C4ISR investment is overall limitations on defense budgets."[83]

Non Technical Interoperability

While technological interoperability is a major issue, other aspects, such as culture, organizational structure, processes and procedures, doctrine and training have a significant impact on the effectiveness and interactions between systems, units and forces in joint and combined operations.[84]In recent years, numerous writers on the subject of interoperability have identified that while technical interoperability is essential to coalition operations, in isolation it cannot ensure the capability of a multinational force.[85] Connectivity of systems between contributing nations does not confer capability. The command and control structures of a

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[82] Warner,Neil. "C2 Interoperability: An Australian National Whole of Government approach." Ninth International Command and Control and Research and Technology Symposium. (Canberra: ADI Limited, 2004), 4.

[83] Adams, Ben-Ari, Logsdon, Williamson. "Bridging the Gap: European C4ISR Capabilities and Transatlantic Interoperability (Washington: The George Washington University, 2004), 8.

[84] Thea Clark and Terry Moon. "Interoperability for Joint and Coalition Operations." (*Australian Defence Force Journal* No 151, 2001),2.

[85] Stewart, Clarke, Goillau, Verrall and Widdowson. "Non Technical Interoperability in Multinational Forces." (Ninth International Command and Control Research and Technology Symposium. Farnbrough,QinetiQ, 2004), 1.

coalition military force can be characterized as: "A complex socio-technical system."[86] In such a system, personnel, processes, procedures and organizational structures interact with technical systems to deliver capability. As such, in a coalition headquarters, there is a nexus between interoperability of technology and interoperability of people, process and organization in order that a combined military capability can be achieved. Through the combination of the two, the potential inefficiencies inherent in multinational headquarters may be mitigated. Friction within a multinational force is often taken to imply a reduction in efficiency of the command and control of the force elements. Kizely observed that: "The frictions generated within a multinational force have the potential to result in 'tempo drag'."[87] The manifestation of this is of particular concern to modern military forces who, have focused on smaller, more mobile units that achieve operational advantages through maneuver and seek to achieve and control the operational tempo. Interoperability challenges exist in coalitions as each military possesses distinct cultures and organizational characteristics. Developing a means to identify and understand these differences will allow the adoption and exploitation of procedures which alleviate interoperability issues

Interoperability Models

Numerous interoperability maturity models exist to provide governments an instrument to examine and improve their ability to work effectively within a coalition or an alliance. This paper will now examine three distinct interoperability models. The U.S. DoD Levels of Information Systems Interoperability (LISI) model was developed by the C4ISR Architecture Working Group in 1998. LISI provides a way of assessing different levels of interoperability for various system to system information exchanges. The model provides a common basis for requirements definitions, incremental system improvements and assessments

[86] Ibid

[87] John Kizely, "Achieving High Tempo: New Challenges"(London, UK: Russi Journal,1999),49.

on the level of interoperability. LISI identifies four enabling attributes to be considered when assessing interoperability: Procedures, Applications, Infrastructure (Hardware, communications, security and system services) and DATA. LISI then uses three metrics to assess the level of compatibility amongst systems: generic, expected and specific. The LISI model has not been universally accepted across the U.S. DoD, however, it is considered a benchmark model and has initiated further models which seek to attain the same end. Clark and Moon state that the model is: "strongly technological and focused on system and technical compatibility."[88] As such, the model provides a strong basis for the development of joint and combined systems so that component systems can interoperate effectively.

In 1999, Australians, Clark and Jones identified that there was a requirement to study organizational interoperability (OI). They developed a model to evaluate interoperability at the human activity and organizational level. They believed that understanding theses issues was essential for effective command and control. The model underwent two revisions and in 2004 Fewel and Clark proposed their Organizational Interoperability Model (OIM) 2004. OIM identifies five levels of organizational interoperability: Unified, Combined, Collaborative, Ad Hoc and Independent. These levels are described by four attributes namely: Preparation, Understanding, Command and Coordination, and Ethos. Preparation, examines the degree of which formal measures such as, doctrine, the establishment of a legal framework, training and experience exist. Understanding, examines the level of information exchange and the degree of shared understanding developed. Command and Control, examines command structures and leadership styles. Finally, ethos covers social-cultural factors such as goals, values and trust.[89]

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[88] Thea Clark and Terry Moon. "Interoperability for Joint and Coalition Operations." (*Australian Defence Force Journal* No 151, 2001),3.

[89] Fewel, Clark, Kingston, Richer and Warne," Evaluation of Organizational Interoperability in a Network Centric Warfare Environment." Ninth International Command and Control Research and Technology Symposium. (Canberra, Defense Science and Technology Organization, 2004),5.

A similar study, known as the Non-Technical Interoperability Framework, was conducted in the UK by QinetiQ which sought to identify non-technical interoperability amongst multinational forces. The aim of the work was to identify non-technical factors which have the potential to undermine optimal interworking and collaboration in a multinational force. QinetiQ identified that the Australian OIM was a useful top level framework, from which further sub categories could be added. It was considered that an index could be developed to: "Allow for more structured assessments."[90] Stewart et El developed a Multinational forces Co-operability Index which could be used to minimize and mitigate friction in training and on operations. The Index provides users with "A means for deriving an assessment of the coalition's performance." [91] The index when used in conjunction with the Non Technical Interoperability framework can provide an indication of the areas which are likely to undermine the efficiency within a multi-national force. The Framework and Index can therefore be used as a diagnostic instrument and potential areas of friction can be identified and appropriate measures adopted to counter them.

These interoperability models seek to improve the capability of forces operating or likely to operate within a coalition. Used in isolation, the models achieve only part of their stated aims; by combining all three models it would be possible to ensure that coalition forces were better prepared. It should be stressed that every situation is different and coalitions are formed out of necessity. As such only generic improvements on interoperability can be achieved prior to the formulation of a coalition.

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[90] Stewart, Clarke, Goillau, Verrall and Widdowson. "Non Technical Interoperability in Multinational Forces." (Ninth International Command and Control Research and Technology Symposium. Farnbrough,QinetiQ, 2004), 6.

[91] Ibid

Joint Strike Fighter Case Study

The Joint Strike Fighter (JSF) program is viewed as the first true test case for whether global licensing agreements can succeed. If the JSF program achieves stated aims within the mandated parameters, the likelihood of future collaborative ventures will significantly increase. The JSF collaboration has and will continue to face multiple domestic and international economic and political obstacles. This case study will analyze the JSF against the perceived advantages and disadvantages of a globalized production and against the issues of interoperability.

In 2005 the JSF program was reported to cost the U.S DoD $200 Billion. [92] International collaboration on the project is significantly reducing the cost of the program and ensures that the program remains viable in an uncertain economic climate. The resulting economy of scale ensures that the acquisition costs for each unit are kept down. This is of course relative. In 2005, the U.S. Government Accountability Office identified the cost of weapon procurement programs costs grew on average by 14.5% while delivery schedules slipped by 19.6% from initial estimates.[93] The soaring costs in weapons programs have resulted in smaller unit buys than in previous eras. For example, in 1951 the U.S. procured a total of 6300 fighter aircraft at a cost of $7 Billion. In 1999 the U.S programmed for 322 fighters at a cost of $11 Billion.[94] The production run for the JSF is estimated to amount to greater than 2000 aircraft. This figure is crucial to maintaining the Unit Recurring Fly – away (URF) costs of $40 million per Air Force unit and $45-50 million for a Navy unit. If the aircraft production total drops, the cost per unit

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[92] Stephen DiDomenico, International Armament Cooperative Programs: Benefits, Liabilities, and Self inflicted wounds – The JSF as a Case Study." (Occasional Paper --Center for Strategy and Technology Air War College: No 55, 2006),6.

[93] GAO report 2005. http://www.gao.gov/new.items/d05301.pdf

[94] Stephen DiDomenico, International Armament Cooperative Programs: Benefits, Liabilities, and Self inflicted wounds – The JSF as a Case Study." (Occasional Paper --Center for Strategy and Technology Air War College: No 55, 2006),17.

increases. Finally, it should be noted that the involvement of partner nations within a weapons program increases funding stability. When the DoD conducts its annual review of acquisitions in order to establish where further money should be spent, programs failing to meet expectations are often cancelled. In addition to this the services are often sent a bill by the OSD comptroller to recoup the costs.[95] The presence of international contributors has a positive effect on the program, the DoD is unlikely to cut a program or reduce its funding if other nations are relying on the outcome.

The JSF program is strengthening existing political and military alliances amongst the participating nations. Seven of the eight participating members are part of NATO whilst the eighth is a member of ANZUS. In addition, four of the members are from ABCA nations. The inclusion of these nations in a high technology weapons program displays a significant amount of trust exists between the nations. This trust will be repaid on future coalition operations as the capability of each member nation is significantly improved and allows for interchangeable mission sets. Finally, the program bolsters both domestic and allied nation industrial bases. Elements of the JSF are being produced in each nation involved in the project. Not only does this ensure jobs in all the countries, it ensures the continued existence of a defense industrial bases which otherwise may be forced to close to due lack of work.

The disadvantages involved in the JSF collaboration are numerous. This case study will examine the principle six issues. The cost of the JSF program rose by an estimated $1 Billion due to federally mandated anti-tamper technology that was added to protect stealth features on the export versions of the JSF. In addition the export versions of the JSF will be built

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[95] Stephen DiDomenico, International Armament Cooperative Programs: Benefits, Liabilities, and Self inflicted wounds – The JSF as a Case Study." (Occasional Paper --Center for Strategy and Technology Air War College: No 55, 2006),28.

with less sensitive and effective low observable features.[96] The resulting aircraft has decreased stealth capabilities, and as such, the radar cross section of the export model is larger than the indigenous version. This inevitably reduces the effectiveness of the fighter and brings into question the USA's willingness to share technology with allies. Information exploitation or reverse engineering of technology is a serious concern of the U.S. DoD. As such, critical and high technology sensors and low observable technology integration is being carefully controlled, produced and maintained by U.S. Depots. Interoperability of the JSF is brought into consideration when you discover that each partner nation is analyzing whether or not the JSF will be able to communicate with coalition partners C4ISR systems.[97] An example of this was highlighted in 2006 when the UK implied that it may pull out of the deal if it was not allowed access to all elements of the system which would be required for operational independence.[98] This again reinforces the dilemma between acquiescing to a partner nation, and relinquishing control of jealously guarded military secrets which could potentially fall into the hands of an industrial competitor or worse. In addition to this, diverse service and partner requirements have already resulted in the aircraft being a compromise rather than an optimized fighter aircraft. For example, one service requirement, such as carrier stability, may be far outside the requirement of another service that a critical capability may have to be compromised.

In collaborative projects, the risk of a partner leaving is ever present. A 2003 GAO report on the JSF identified that: "Differing expectations between the U.S and its partner is

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[96] Lavallee, Tara M. "To Cooperate or Not, that is the Question: Transnational Security and Defense Cooperation." (Conference Papers - - International Studies Association: 1, 2006), 25.

[97] Stephen DiDomenico, International Armament Cooperative Programs: Benefits, Liabilities, and Self inflicted wounds – The JSF as a Case Study." (Occasional Paper --Center for Strategy and Technology Air War College: No 55, 2006),41.

[98] International Fleet Review , "Joint Strike Fighter hits Turbelence" (May 2006) http://www.warshipsifr.com/navalNewsAnalysisMay06.html

inevitable."[99] International members of the program have made numerous complaints that their expectations concerning technology transfer and work share have not been met. The issue of work share has proved an emotive issue during the JSF development and production process. Numerous approaches to sourcing of contracts were experimented with and each one was met with disdain by either foreign or domestic markets. One complaint made by a U.S. stakeholder was: " …Why they were spending more money on poorer performance."[100] Escalating unit costs due to a U.S reduction in buy, development delays and production delays are all possible factors which may force a collaborating nation to leave the program. Risk of partner defection is troubling; however, nothing will bring on the collapse as a program like the country lead cancelling the program due to the assumption of too much risk.

In 2003 a GAO report established that the JSF program required stronger management and oversight, as international participants: "Currently have no requirement or incentive to share in cost growth."[101]As costs grow in the project, the burden is carried by the U.S. as there is no requirement for partners to inject more money to cover their commensurate share beyond the originally agreed upon target costs. Finally, the loss of jobs to an overseas market is a significant concern. Not only are jobs lost at home, the industry at home may also face increased competition from newly energized arms manufacturers who have received contracts from the JSF project. Perhaps most frustratingly, collaborative arms projects are renowned for

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[99] GAO report 2003. http://www.gao.gov/new.items/d05301.pdf

[100] Stephen DiDomenico, International Armament Cooperative Programs: Benefits, Liabilities, and Self inflicted wounds – The JSF as a Case Study." (Occasional Paper --Center for Strategy and Technology Air War College: No 55, 2006),34.

[101] Stephen DiDomenico, International Armament Cooperative Programs: Benefits, Liabilities, and Self inflicted wounds – The JSF as a Case Study." (Occasional Paper --Center for Strategy and Technology Air War College: No 55, 2006),36.

failing to meet projected production and delivery dates. The work share process slows the production tempo and delays in one country can produce exponential delays to the entire project.

In examining the JSF it becomes clear that there are very few linkages between a globalized arms industry and a more interoperable military force at the coalition level. The economic and national security concerns of the lead nation within a project will dictate the level of technology transfer and almost certainly the lead nation will remain the 'gatekeeper' of technology even in the case of close allies.

Relationship between Arms Industry Globalization and Interoperability

The relationship between Arms industry globalization and improvements in interoperability amongst coalition forces is extremely tenuous. It is clear that collaboration on arms projects has increased significantly since the end of the Cold War; however, interoperability amongst coalition forces remains a serious issue. Fundamentally, it is not a technological issue, the UK, Canada and Australia are heavily involved in the R&D process and in some cases they are currently at the cutting edge of technological advancement. Ultimately, the issue comes down to economics, with the exception of the United States; defense spending has reduced in real dollar terms since the end of the Cold War. In order to close what is perceived as a technological interoperability gap, coalition governments would be required to significantly increase defense expenditure. In the current economic and security climate no coalition government is in a position nor has the incentive to increase defense spending.

National security remains a formidable challenge to interoperability. The U.S. is extremely concerned that defense technology may fall into the hands of undesirable users through third party proliferation. The resulting balance of power change and the loss of technological overmatch are paramount in U.S. Strategic thought. Suffice to say, in a globalized arms market technology transfers occur rapidly and attempts to stifle them are met with concerns that

technological advancement is being delayed. Proliferation of defense technology does occur 'under the radar' as civilian firms and technology are heavily involved in the arms industry and regulation of dual use technology is next to impossible. It is certain, however, that governments will remain critical 'gatekeepers' of technology and will block attempts which seek to proliferate technology on purely economic grounds.

Surprisingly, the non technological interoperability factors play an important role in explaining the lack of interoperability amongst coalition forces. Despite the existence of forums and working groups to enhance standardization and interoperability amongst forces, the coalition's capabilities are still not optimized. Doctrinal, cultural and command and control differences exist between the members of the coalition. It has never been truer to state that we are five countries separated by a common language. It should be stressed, since 1946 the levels of multinational interaction have been lowered to the tactical echelons, where as in the past it was firmly lodged in the strategic and operational level. This has introduced new complexities into the multinational force. Command and control of a multi-national Battlegroup level force requires extremely different systems and procedures than at the operational level.

Conclusion

In conclusion, the apparent nexus between a globalized arms industry and an increased level of interoperability has proved to be elusive. Whilst it is true that globalization of the arms industry has increased the number of arms collaboration projects and shared the production of weapons. The interaction of coalition forces in Afghanistan and Iraq demonstrates that high levels of interoperability amongst national contingents are still a long way off. National security constraints restrict the transfer of cutting edge technology, which in turn limits technical interoperability between nations. Confusingly, the reliance on civilian industry and the use of dual use technology in weapon systems has assisted proliferation of defense technology but has not improved interoperability. This issue is further compounded by the fact that NATO, U.S. and

UK doctrine stress the importance of technical interoperability and focus little emphasis in the areas of non technical interoperability. This may seem a mute point, however, despite sharing a common language the military cultures of the ABCA nations differs dramatically. The doctrine and processes of each nation are similar; however, there is divergence and this divergence leads to misunderstandings and is responsible for more than its fair share of Clausewitzian Friction. Perhaps the most depressing issue concerning interoperability lies in the fact that there have been organizations responsible for improving coalition interoperability for over 60 years. Both the ABCA program and NATO have sought to address standardization and interoperability of forces within a coalition and alliance setting. The advances made by these organizations are tangible, unfortunately political and economic factors have reduced their effectiveness. Frustratingly the level at which national contingents interact are at the lowest they ever have been, yet forces are still not interoperable. There is a clear to need to improve tactical interoperability amongst coalition forces. While much can be accomplished through training and understanding partner capabilities there is still a pressing requirement to ensure that forces on the ground can pass timely and accurate information between each other in order to achieve mission success.

Recommendations

Significant changes in the Global arms industry suggest that is within the art of the possible to dramatically improve the levels interoperability amongst coalition forces. Unfortunately, as previously mentioned numerous barriers exist which prevent truly interoperable forces. The defense spending gap amongst ABCA and NATO countries is the major inhibitor to interoperability. U.S. spending on R&D and introduction of new systems is superior to that of all NATO nations. The gulf in capabilities grows on a monthly basis and as such without increased defense spending by other NATO nations the gap is likely to reach a level where forces are unable to achieve technical interoperability. Convincing national leaders that increased defense spending is essential to the viability of future military operations. Current economic conditions

and the apparent lack of existential threat reduce the motivation and will amongst world leaders to increase defense spending. Democratic leaders are unwilling and unable to convince their respective populations that defense is a paramount concern in the 21st century. The importance of informing populations and leaders of the potential sources of instability must be the goal of every member of the defense community. Without this, low levels of defense spending will limit the capability of military forces to operate within a coalition. National security is intrinsically linked to economics in defense spending.

The U.S. is concerned with the proliferation of defense technologies to third parties who are potential adversaries. This is understandable; however, numerous nations have displayed a willingness to cooperate with the U.S. on numerous foreign policy issues for over 60 years. Nations with a proven track record of support and the ability to control proliferation must be afforded access to advanced technologies. Without this access, the gulf in interoperability levels between U.S forces will grow to levels where tactical and operational formations, within a coalition, are unable to operate together within the same battle space. In an era where unilateral action is unfavorable, this will prove a significant challenge to future military operations. To ensure both economic and national security issues are addressed and that interoperability is achieved existing alliances and forums must enforce standardization.

From their inception, NATO and ABCA sought to standardize the militaries of their member nations. Unfortunately despite significant effort, the level of interoperability amongst their member nations remains woefully low. Currently NATO Standardization Agreements (STANAG'S), which seek to establish technical interoperability amongst systems, are voluntary agreements. NATO must enforce these STANAG's rigidly and penalize those nations which fail to meet the required standard. NATO guarantees collective defense and provides both diplomatic "soft power" and military "hard power" to its members. These benefits should come at a price and that price is conforming to the standards articulated in the NATO handbook. These

recommendations address technical interoperability; however, non technical interoperability is just as important.

Understanding the military culture of other nations is a start point for non technical interoperability. The processes, procedures and organizational structures of militaries differ from country to country. Failure to fully comprehend these issues will lead to inefficiencies within a coalition organization. To improve understanding amongst potential coalition members the need to conduct combined training at all levels is paramount. Unbelievably, despite fighting alongside each other since 2001, U.S. and UK forces have conducted limited pre-deployment training together. The same can be said of the other major coalition contributors to Afghanistan and Iraq. It should come as no surprise that misunderstandings and errors occur within coalition headquarters and at the tactical level. When using the Organizational Interoperability Model (OIM) to measure the level of non technical interoperability between the forces of the UK and U.S. deployed in the same theater of operations, the results are worrying. Doctrine and training differ between the two forces despite an ongoing relationship which has lasted for over 60 years. Information exchange and the level of shared understanding vary but are often suboptimal. Command and leadership styles differ and have been the source of much consternation between the two nations. Finally, the values and trust between the two forces have been called into question on numerous occasions and as such have further eroded capability.

This situation is unacceptable given the shared goals of the two nations; more troublesome is this has resulted despite long standing relations. How can coalition interoperability be achieved within a coalition of the willing who lack long standing agreements and alliances. Significant emphasis must be placed on non- technical interoperability? How to achieve this is a question which requires extensive research and is beyond the scope of this study.

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